CLAIMS

WHAT IS CLAIMED:

1. A semiconductor structure, comprising:

a dielectric layer;

a metal-containing region formed in said dielectric layer, said metal-containing region having at least one copper surface; and

a silicon and nitrogen-containing dielectric barrier layer formed on said at least one copper surface, said silicon and nitrogen-containing barrier layer having a first surface in contact with said at least one copper surface and a second distal surface, wherein a silicon concentration at the second surface is greater than the silicon concentration at the first surface of said barrier layer.

2. The semiconductor structure of claim 1, wherein said silicon and nitrogen-containing dielectric barrier layer comprises silicon nitride.

3. The semiconductor structure of claim 1, wherein said metal-containing region comprises copper and a metal-containing barrier layer.

4. The semiconductor structure of claim 1, wherein a thickness of said silicon and nitrogen-containing dielectric barrier layer is in the range of approximately 20-70 nm.

5. The semiconductor structure of claim 1, wherein said silicon and nitrogen-containing dielectric layer comprises a silicon nitride layer and a silicon-rich silicon nitride layer.

6. The semiconductor structure of claim 5, wherein a thickness of said silicon nitride layer is in the range of approximately 2-10 nm.

7. The semiconductor structure of claim 5, wherein a thickness of said silicon-rich silicon nitride layer is in the range of approximately 20-70 nm.

8. The semiconductor structure of claim 1, wherein said silicon and nitrogen-containing dielectric barrier layer comprises an intermediate layer with a gradually varying silicon concentration.

9. The semiconductor structure of claim 8, wherein a thickness of said intermediate layer is in the range of approximately 0.5-2 nm.

10. A method of forming a dielectric barrier layer, the method comprising:

forming a first silicon nitride layer on an exposed copper surface; and

forming a second silicon nitride layer on said first silicon nitride layer while adjusting a silicon concentration of said second silicon nitride layer to be higher than that of said first silicon nitride layer.

11. The method of claim 10, wherein said first and second silicon nitride layers are formed without interrupting a vacuum.

12. The method of claim 10, wherein said second silicon nitride layer is formed while changing a first set of deposition parameters to a second set of deposition parameters.

13. The method of claim 10, wherein said first silicon nitride layer is formed with a first set of a deposition parameters and said second silicon nitride layer is formed with a second set of deposition parameters, and deposition of said first silicon nitride layer is stopped prior to establishing said second set of parameters.

14. The method of claim 12, wherein said first set of deposition parameters includes at least one of a silane flow rate and an ammonia flow rate.

15. The method of claim 13, wherein said first set of deposition parameters includes at least one of a silane flow rate and an ammonia flow rate.

16. The method of claim 13, wherein said first and second silicon nitride layers are deposited in an plasma ambient.

17. The method of claim 16, wherein said plasma ambient is controlled so as to stop the formation of said first silicon nitride layer prior to forming said second silicon nitride layer.

18. The method of claim 10, wherein a thickness of said first silicon nitride layer is in the range of approximately 2-10 nm.

19. The method of claim 10, wherein a thickness of said first silicon nitride layer is in the range of approximately 20-70 nanometer.

20. The method of claim 10, further comprising treating said exposed copper surface by exposing the copper surface to a plasma ambient prior to forming said first silicon nitride layer.

21. The method of claim 20, wherein treating said copper surface and forming said first silicon nitride layer is performed without interrupting a vacuum established over said copper surface.

22. The method of claim 21, wherein said second silicon nitride layer is formed without interrupting said vacuum.